Sudan Grass

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Sudan Grass

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Sudan grass [2] was introduced into the United States in 1909 from Africa. It was first planted at Chillicothe, Tex., where it proved promising. Since then it has been widely distributed and used throughout the United States, as well as other parts of the world.

Description

F&R 10552

FIGURE 1.—Single plant of Sudan grass, illustrating its growth when planted in rows.

Sudan grass is an annual. Ordinarily it grows from 3 to 5 feet high and has stems about three-sixteenths of an inch in diameter. However, if grown in rows (fig. 1) and cultivated, it reaches a height of from 6 to 8 feet, and the stems are about one-fourth of an inch in diameter.

The panicle, which is approximately 15 to 30 inches long and about half as wide, is erect and open. The spikelets are without stems. The hulls, or glumes, are awned and when in flower are often purplish. The grain usually fades to a pale yellow when ripe. Since the awns are broken off in threshing, the commercial seeds rarely have them. The leaves are broad and numerous.

Underground rootstocks or stems are absent. Like the cultivated sorghums Sudan grass develops only fibrous roots and, therefore, cannot become a noxious weed. This grass tillers freely when given ample space. It is not uncommon to find over 100 stems arising from 1 crown.

Varieties

The widespread use of Sudan grass has been limited in certain areas by severe attacks of foliage diseases and other factors. Plant breeders have been successful in developing superior varieties characterized by increased disease resistance, higher yields, increased leafiness, sweet stems, early or late maturity, and lower prussic acid content. The success of the breeding programs can be attributed largely to the ability of Sudan grass to hybridize freely with other sorghum species. Desirable character-

[1] The previous edition of this bulletin was prepared by H. N. Vinall.

[2] *Sorghum sudanense.*

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istics can be transferred to Sudan grass from grain and forage sorghums and Johnson grass. As a result, several varieties are being increased commercially and new strains are being tested.

Before buying Sudan grass seed the farmer should determine the variety best adapted to his locality.

Wheeler

This variety was selected for seedling vigor, early maturity, and uniformity of fine stems. It was the first variety of Sudan grass released, being offered for sale in 1915. Because of its extreme earliness and disease susceptibility the acreage is limited.

Sweet

Sweet Sudan grass (Texas SA 372) was developed in 1932. It is highly palatable because of its sweet, juicy stems. Its sienna-colored glume makes possible the detection of a mechanical mixture with Johnson grass. This variety has some resistance to foliage diseases, charcoal rot,[3] and chinch bugs.[4] It has high seed production and less seed shattering than most other varieties. It grows more slowly in early spring than common Sudan grass but remains green and is more palatable later in the summer and fall. Forage yields are above those of common Sudan. It is adapted to the southern Corn Belt and southern Great Plains region. Certified seed is in good supply.

Texas SA 372 (S–1), a selection from the preceding variety, is a freely tillering, fine-stem type. It is highly uniform in seed and vegetative characteristics in the west Texas seed-producing area. Certified seed is produced in Texas.

Tift

Tift Sudan grass was developed in 1936. It has the basic tan plant color and a mixture of chocolate- and tan-colored seeds. It is rather leafy because of its habit of stooling from most of the lower nodes. Most of the stems are pithy. It matures slightly later than other Sudan grass varieties and tends to develop slower than common Sudan. Chemical analyses have shown that disease-free leaves are higher in protein and total digestible nutrients than diseased leaves. Its main advantage is its disease resistance, in which it surpasses all other commercial varieties. During heavy disease epidemics in the Southeast, Tift Sudan has produced grazing for a month or more after common and Sweet Sudan have died.

It is best adapted to the humid Southeastern United States and parts of Texas. Certified seed is available.

Piper

Piper is the result of a double-cross made in 1942. It is characterized by good vigor and early maturity, and it has a low level of prussic acid. It has some resistance to leaf blight and anthracnose. Piper is rather variable in seed and foliage color. Most of the stems are pithy. This variety develops more rapidly than Tift.

It is well adapted to the northern Corn Belt States and the northeastern region, where it is recommended by several States. Certified seed supplies are adequate.

Lahoma

Lahoma is a sweet Sudan grass selected in 1949. It is a late-maturing and usually drought-resistant variety that tillers well. Its wide leaf is a distinctive yellow green. This grass contains relatively more prussic acid than the common types

[3] The causal organisms of Sudan grass diseases are given on p. 13.

[4] For the scientific names of insects mentioned in this bulletin, see p. 13.

but no more than the other sweet Sudans. The seeds range in color from apricot to sienna.

It is adapted to the entire State of Oklahoma, but leaf diseases may affect its production in the more humid areas. The variety is being increased under the certification program in Oklahoma.

Greenleaf

Greenleaf was selected in 1952. It is a vigorous leafy variety that tillers well. Most of the stems are pithy. It matures later than most other varieties. Because of its late maturity and good vigor it produces high yields under favorable soil and moisture conditions. It is somewhat resistant to leaf blight and anthracnose and also to some bacterial foliage diseases. The glumes are mahogany colored. When fully ripe, a large percentage of the seeds will thresh free from the glumes. Compared with the other varieties it has an average prussic acid content. It is not very different from Wheeler, a standard variety used in Kansas.

It appears best adapted to the central latitude in the Midwest. Certified seed is available.

Climatic Requirements

Sudan grass, like the sorghums, does best in a warm climate. In favorable seasons where the growing period is long, as many as 4 cuttings can be obtained in 1 year.

Sudan grass is now being grown where it was at first thought to be wholly unadapted. Its short growing period permits it to thrive and produce good crops of hay as far north as Michigan and New York. In the Rocky Mountain region the conditions are for the most part unfavorable, except in the irrigated valleys. At the higher altitudes untimely frosts and continued low temperatures during the summer months preclude successful growth. The upper limits for profitable hay production seem to be 6,000 to 8,000 feet in New Mexico, Arizona, and southern California; 5,000 to 6,000 feet in Colorado, Utah, Nevada, and northern California; and 4,000 to 5,000 feet north of these States.

The altitudinal limits for seed production are at least 1,000 feet lower, respectively, than those given for hay, because in a cool climate it takes a month or more for seed to mature after the crop is ready to be cut for hay.

Soil and Fertilizer Requirements

Sudan grass is not exacting in its soil requirements. It does best on a rich loam, but it has been grown successfully on almost every type of soil from a heavy clay to a light sand. However, where the soil is sandy, the yield may be light unless the crops are supplied with adequate amounts of fertilizer. Cold, wet soils are particularly unsuited for Sudan grass, and thorough drainage must be provided before Sudan can succeed. Small amounts of alkali in the soil reduce yields markedly, and stronger concentrations prevent profitable culture. Sudan grass is not especially sensitive to soil acidity. It grows well on soils with a pH of 5.5.

The fertilizer requirements of Sudan grass are similar to those of other annual grass crops or corn. Since Sudan grass grows rapidly, an adequate supply of nitrogen at planting time will insure establishment and hasten development. Even on fertile soils some nitrogen or a complete fertilizer is frequently advisable. The amounts to use will depend on the natural fer-

tility and soil type of the area. The usual recommendation per acre in the Northeastern United States is 150 to 250 pounds of 10–10–10; in the Midwest, 200 to 300 pounds of 3–12–6 or similar ratio; and in the West for irrigated lands, 30 to 60 pounds of nitrogen. Phosphorus and potash should be applied where they are lacking. Sudan grass will also make good use of barnyard manure. The important point is to use the fertilizer that is best for the production of grass in any given area and one that will insure rapid establishment and growth.

Culture for Pasture, Hay, and Seed Production

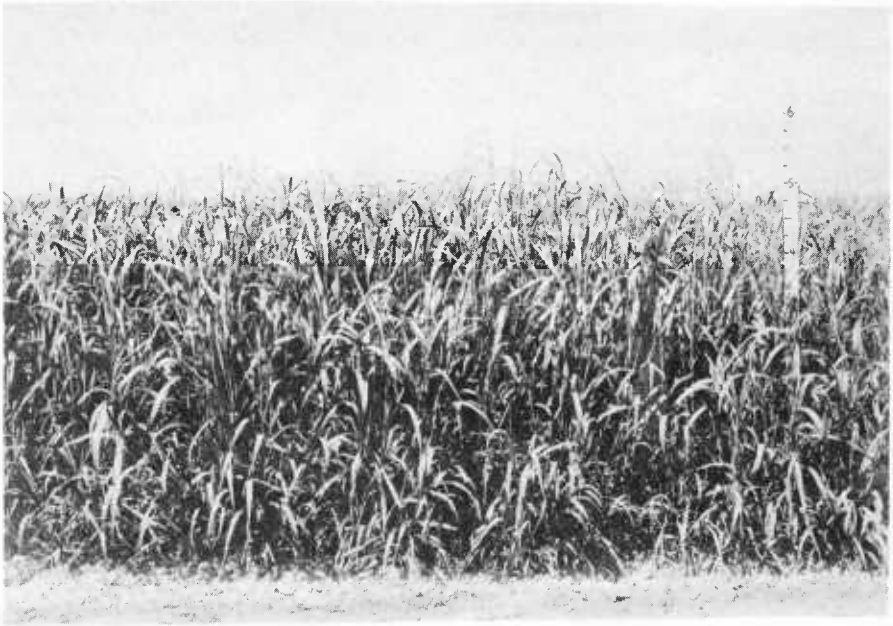
Preparation of the Seedbed

Since a cool soil delays germination of the seed, spring plowing is preferable because it helps warm the soil. A firm, well-prepared seedbed is essential for best results, because many of the annual weeds can be eradicated in its preparation.

Date of Seeding

Sudan grass should be seeded after the soil has become warm, or about 2 weeks after corn-planting time. Planting in cold soil results in poor stands or slow growth with weed encroachment.

In the extreme South the best seeding time for a pasture or hay crop is between April 1 and May 1; in the latitude of Oklahoma and Kansas, between May 1 and June 15 (fig. 2); and in the latitude of Nebraska and South Dakota, between May 15 and June 15. In the Northeastern States the optimum seeding time is from June 10 to 25, although seedings may be made as late as July 15. However, this late



F&R 13133

FIGURE 2.—Field of Sudan grass seeded with a grain drill on June 1, showing growth on August 12 at Hays, Kans.

planting shortens the grazing season.

Plantings primarily for seed production should be made between June 1 and 15. About 110 days are required to produce a seed crop planted at this time.

Isolation and Land Requirement for Seed Production

Sudan grass hybridizes very freely with sorghum, especially with the sorgos. A field intended for a seed crop should be planted 60 to 80 rods from any sorghum, particularly in dry regions where pollen is carried for considerable distances by the wind. Fields that have been used for crops other than sorghum should be chosen for the Sudan grass seed crop, since volunteer sorghum plants are sometimes found in fields planted to sorghum the previous year, and cross-pollination and a mechanical mixture would result.

To insure varietal purity, seed of the improved varieties should be grown under certification standards. These standards have been developed by the Crop Improvement Associations of the States in which this seed is grown. Specific standards are given as to isolation, land requirements, and other factors necessary to maintain varietal identity and quality of seed.

Method of Seeding

The best machine for seeding is the grain drill. Well-cleaned seed can be fed freely from this drill and distributed evenly, and a good stand is secured. The depth of seeding has but little effect on the root system of Sudan grass, which begins near the surface of the soil. The best depth is about 1 inch. Where the soil does not become packed, the plant will force itself to the surface even from a depth of 3½ to 4 inches.

In the semiarid regions for hay and in any locality for seed production, best results are obtained by seeding in rows far enough apart to allow for cultivation. This can be accomplished by stopping up a sufficient number of holes in a grain drill, so that the rows will be the desired distance apart. In using ordinary cultivators for the work it is best to place the rows 36 to 44 inches apart. Nearly all Sudan grass seed is produced from row plantings (fig. 3). Larger yields can be secured from rows 18 to 24 inches apart, provided the moisture is adequate.

Better quality hay can be obtained from broadcast plantings, owing to the finer stems produced in thick stands. The grass grown in cultivated rows is likely to be coarse and, therefore, not so desirable for hay or pasture.

Rate of Seeding

Rates of 10 to 40 pounds of seed to the acre have been tested at various agricultural experiment stations. For drilled seedings, the results indicate no definite superiority for any one of the rates within that range. Sudan grass tillers so profusely in thin stands that the final number of stems per square foot of ground is usually very nearly the same, whether the rate is 15 or 40 pounds.

For drilled or broadcast seedings, taking all the factors into consideration, 20 to 25 pounds of seed per acre are recommended in the humid regions and 12 to 15 pounds in the dry sections. In irrigated areas 15 to 20 pounds of seed are sufficient, owing to the more favorable conditions for germination. These quantities should be proportionately increased if the seed is of low germination or the soil is in poor physical condition. Since Sudan grass seed loses its viability more rapidly than many forage seeds, it is important to know its germination. A grain drill set to sow 2 pecks of wheat to the acre will ordi-

F&R 11279

FIGURE 3.—Sudan grass planted in rows 42 inches apart for seed production.

narily sow about 20 to 25 pounds of Sudan grass seed per acre.

For seeding in cultivated rows 36 to 44 inches apart, 3 to 6 pounds of seed per acre are sufficient, whereas rows 18 to 24 inches apart require 6 to 8 pounds per acre, the smaller quantity being used, as in the drilled or broadcast seedings, for regions of light rainfall. If the crop is intended for hay, enough seed should be used to insure a thick stand of plants in the row. When a seed crop is desired, the rate of seeding should be slightly less.

Harvesting for Hay

The most common way of harvesting the grass for hay is with a mower. Because of the large amount of juice in the stems of Sudan grass, the leaves cure first, and the hay often appears ready to be put into storage when it is not; therefore, the only way to avoid injury by heating is to allow Sudan grass to remain in shock or windrow long enough for the stems to become dry. The leaves keep well, and if the grass is cut at the right stage of maturity and handled properly, it will make a bright leafy sweet hay of high quality.

The time of cutting is sometimes governed by the number of cuttings desired. Often it seems more profitable to cut the first time as early as possible, so that the grass will have more time for the second growth. However, experiments have shown that early cutting is not justifiable from the standpoint of total yield. At the Fort Hays Experiment Station, Hays, Kans., the average seasonal yield of air-dry hay for 5 years was as follows:

Stage when cut	*Tons per acre*
Just before heading	1.86
As first heads appear	2.23
When in full head	2.15
When seed is in milk	2.28

In the first stage 2 cuttings were obtained each year, in the second stage 2 cuttings in 3 out of 4 years, and in the third stage 2 cuttings in only 2 of the years. In the fourth stage only 1 cutting a year was obtained, but the average yield was higher than in the other 3 methods.

The Agricultural Experiment Station of Cornell University at Ithaca, N. Y., reported a 5-year average hay yield of 6,000 pounds per acre from 2 cuttings of common Sudan. The first cutting was made 12 weeks after seeding and the second cutting when the seed was formed and in the soft-dough stage. However, when 3 cuttings were made—the first 8 weeks after seeding, the second 27 days after the first cutting, and the third 28 days later—the total yield was only 3,551 pounds of hay.

The preferred stage of maturity for cutting hay is from the time it begins heading until it is fully headed. If well-adapted, disease-resistant varieties are used, harvesting may be extended over a long period without material loss in the quantity or quality of the hay.

Harvesting for Seed

The seed crop is harvested when most heads on the main portion of the stem are ripe. Delaying the harvest until after this time may result in excessive shattering.

The crop is usually cut with a binder, shocked, and threshed with either a combine or a thresher. It can also be cut and allowed to cure in the swath for about a week. A 6- to 8-inch stubble will hold the crop off the ground and permit air circulation and rapid drying. Harvesting from the swath is done with the combine. Cylinder speed should be reduced enough to prevent damage to the seed.

Direct combining of standing Sudan is not recommended, because the plants have to be more mature before harvesting and excessive shattering results. Also green pieces of stems and hulls are not separated readily from the seed and may cause heating and damage to germination.

Seed Yields

Seed yields range from 600 to 3,000 pounds per acre. A good seed producer, such as Sweet sudan, has yielded as much as 1,800 pounds of seed per acre in the southern Great Plains. The 1944–53 average seed yield in California was 816 pounds per acre, and the 1954 and 1955 average yields were 1,000 and 1,350 pounds per acre, respectively.

The accepted weight in the trade for Sudan grass is 40 pounds per bushel, and there are 55,000 seeds in a pound.

Most of the commercial Sudan grass seed is produced in Texas, California, Colorado, and New Mexico, but Kansas, Nebraska, Oklahoma, and Oregon also produce more seed than is needed for local consumption. Seed yields per acre are largest in the irrigated areas of California.

Utilization

Pasture

Sudan grass has attained its greatest popularity as a temporary or supplemental summer pasture crop. It is a valuable pasture plant in many regions of the United States and fills an important need, since it grows during the summer when other sources of pasturage are short or lacking. It is used by all kinds of livestock. Dairymen make extensive use of Sudan grass. In western Kansas it furnished abundant pasturage at the rate of 1 cow per acre for 125 days, and the cows produced almost 4.0 pounds more milk per cow on Sudan grass than on native-grass pasture. The rate of gain for beef cattle or sheep is equal to that with other kinds of green feed. Beef cattle gains of 2.5

pounds per head per day are common.

Although Sudan grass is palatable and readily eaten at the early heading stage, recovery will be better when it is grazed at an earlier stage of growth. Pasturing should be delayed until the stand is at least 18 to 24 inches high. It is advisable to divide the Sudan grass pastures into fields of such size that they will be grazed down quickly. Under such a practice of rotational grazing the carrying capacity per acre for a short period is 6 or more animals. This practice will keep the growth young, succulent, and highly nutritious throughout the grazing season.

Hay

Although Sudan is primarily a temporary pasture grass, the hay is relished by cattle, horses, and sheep. The feeding value of Sudan grass hay is practically equal to that of millet, timothy, Johnson grass, and other nonlegume roughages.

Beef cattle were maintained economically by the Kansas Agricultural Experiment Station on a ration of Sudan grass hay, sorghum silage, and a small supplementary ration of linseed or cottonseed meal. In another feeding experiment dairy cows produced 97.8 percent as much milk when fed Sudan grass hay as alfalfa hay.

Silage

Sudan grass makes acceptable silage for beef and dairy cattle, as well as sheep, when properly ensiled. Sheep prefer corn silage but accept Sudan grass silage equally as well as grain sorghum silage. Many analyses have shown that Sudan grass silage has about the same chemical composition as corn silage.

Mixtures of Sudan grass and soybeans can be grown for silage in humid regions. They make a bright-colored palatable silage of high feeding value. The Illinois Experiment Station reported that Sudan-soybean mixtures harvested for silage in mid-July yielded 22,000 pounds of green material containing 15.7 percent of dry matter, or about 3,400 pounds of dry matter per acre, whereas similar mixtures harvested in mid-August yielded 24,000 to 26,000 pounds of green material, or about 6,000 pounds of dry matter per acre.

Feeding tests with dairy cattle showed that the cows ate 8 percent less Sudan-soybean silage and produced about 3 percent less milk than cows fed corn silage during the same period. The results also indicated that slightly immature Sudan-soybean silage was superior to the more mature material. These results were with common Sudan grass. Tests have indicated that Sweet Sudan grass makes a better quality silage.

Prussic Acid Poisoning

Sudan grass contains less prussic acid than the grain sorghums. The prussic acid content is reduced to such a small amount by the time the grass is tall enough to be pastured (18 to 24 inches) that there is little danger of poisoning. The plants have more prussic acid if the soil is high in nitrogen and deficient in phosphorus and potash. Prussic acid is present in appreciable amounts only in the rapidly growing part of the plant, which is a very small proportion of a plant 18 inches or more in height.

Young second growth that follows clipping, drought, frost, or grazing contains more prussic acid than does the first growth. The grass should reach a height of 18 inches before cattle are allowed to have full feeding of it.

Diseases and Their Control[5]

Bacterial Diseases

Sudan grass is subject to serious attack by three bacterial diseases. Bacterial eye spot disease is characterized by round or elliptical, sometimes irregular, lesions on the leaves, which vary from 1 to 8 mm. in diameter. At first the spots are dark green and water soaked, but soon they become dry and have a tan parchmentlike center with a red border. Very small lesions are red throughout. The disease also affects corn, pearl millet, foxtail millet, Johnson grass, and the sorghums.

In bacterial streak disease the lesions on the leaves are first narrow water-soaked streaks 2 to 3 mm. broad and 2 to 15 cm. or more long. Soon red-brown blotches appear in these streaks, and in a few days the entire lesions are reddish brown. When numerous they merge to form long irregular areas that cover much of the leaf blade. Dead tissue with narrow dark margins between the reddish-brown streaks ultimately comprises the affected areas. Bacterial exudate is abundant, standing out on the young lesions as light-yellow beads. It dries to thin white or cream-colored scales. The bacteria that cause this disease also attack Johnson grass and the sorghums.

Bacterial stripe disease is characterized by elongated red streaks and blotches on the leaves, with red crusts of dried bacterial exudate on the lower surface. The stripes may be narrow and bounded by veins, or they may fuse and cover a large part of the leaf surface. The lesions are most abundant on the leaves but may extend to the sheaths and stalks. The ends of the lesions may be blunt or extended into long jagged points. The lesions are brick red to dark purplish red throughout. This disease also occurs on Johnson grass and the sorghums.

The bacteria causing these diseases are spread from leaf to leaf by splashing and blowing rain and possibly by wind and insects. In moist, warm weather the bacterial lesions increase rapidly in number and size. Under these conditions they are capable of killing much of the leaf surface. There is evidence that these parasites may be carried over the winter in or on the seed and that they may overwinter also in the soil.

Crop rotation and selection of seed from fields free from the diseases are suggested as control measures. Greenleaf, Lahoma, Piper, and Tift are not severely damaged by the bacterial diseases.

Leaf Blight

Leaf blight of Sudan grass is caused by a fungus that produces elongated straw-colored lesions with reddish-brown or brownish margins on the leaves. As the season progresses the enlarging lesions merge until large portions of the leaves are involved. The tissue in the affected areas is dry and cracks develop until eventually the leaves may be shredded into ribbons by the wind. The disease generally becomes evident in late summer or early fall. After a rainy period it may appear as a sudden scorch of the leaves, as if the plants had been injured by an early frost. The spore-bearing threads and the dark spores of the causal fungus often appear as a black fuzzy growth on the straw-colored lesions.

The fungus occurs also on the seed of Sudan grass. Seed treat-

[5] Prepared by K. W. Kreitlow, plant pathologist, Field Crops Research Branch. For additional information, see Farmers' Bulletin 1959, Sorghum Diseases and Their Control (rev. 1951).

ment with Arasan or Spergon [6] may prove beneficial in controlling this seedborne infection. Tift, Piper, and Greenleaf Sudan grasses are somewhat resistant to leaf blight.

Target Spot

The fungus that causes target spot attacks related grasses in the Southern United States. The well-defined spots on the leaves are tan on Tift and reddish purple on common Sudan grass. Older lesions usually have a target or zonate pattern with alternate light and dark bands. The lesions vary from tiny round or elliptical spots to those that are more elongate and rather extensive. The lesions sometimes grow together so that most of the leaf area is affected.

The disease is possibly seedborne. Seed treatment with Arasan or Spergon should be effective in preventing spread into new areas. No highly resistant varieties are known; however, Tift has some resistance to the disease. Crop rotation and adequate fertilizer applications aid in reducing damage.

Anthracnose

Anthracnose of Sudan grass occurs throughout most of the United States. The disease has been especially severe in some years in the Southeastern States. Anthracnose is characterized by small reddish-brown round lesions on the leaves. At first they are only a few millimeters in diameter, but under favorable conditions they become confluent, and large areas of the leaves are killed. The minute spore-bearing bodies of the fungus occur abundantly as tiny dark dots on the mature lesions.

Clean culture and crop rotation aid in controlling anthracnose. Tift, Piper, and Greenleaf Sudan grass are somewhat resistant.

Rough Spot

This disease is characterized at first by small irregular brick-red spots on the leaves. Under favorable conditions they become elongate and rapidly coalesce, affecting large portions of the leaves. Eventually entire leaves are killed and turn reddish brown. At this stage the disease lesions often appear as dark-purple streaks. The tiny black fruiting dots of the fungus are visible in the early stages of development of the spots, and after the leaf dies they develop abundantly on dead brown tissues between the purplish streaks. Such leaves feel like sandpaper when rubbed between the fingers.

Sudan grass should not be grown on land where rough spot occurred the preceding season. No resistant varieties are available.

Gray Leaf Spot

This disease occurs commonly on the leaves of Sudan grass in the warm, humid sections near the Gulf of Mexico. Young spots are reddish purple or tan, but as they enlarge they become covered with a grayish-white fungus growth.

Clean culture and rotation aid in holding gray leaf spot in check. No resistant varieties are known.

Zonate Leaf Spot

This fungus disease occurs on the leaves of Sudan grass in the Gulf States. It is characterized by conspicuous spots composed of alternating bands of reddish-purple and tan tissue. Such spots commonly form semicircular patterns along the margins of the leaves. They are much larger than target spot lesions and may unite to cover most of the leaf surface.

As with other foliar diseases of Sudan grass, clean culture and ro-

[6] Mention of trade products in this bulletin does not imply their endorsement by the U. S. Department of Agriculture over similar products not named.

tation aid in controlling zonate leaf spot. Some introductions of sorgo from Africa appear highly resistant to this disease, and ultimately it may be possible to incorporate high resistance into Sudan grass through hybridization. Tift and Greenleaf appear to be the most resistant varieties.

Leaf Rust

Leaf rust, a fungus disease, appears on the leaves of Sudan grass as raised pustules, or blisters, covered with a brownish coating that eventually ruptures and allows the dark-brown rust spores to escape. These spores are spread by wind and rain and cause secondary infections. Severely rusted leaves dry and break off and thus reduce the forage value of the crop. The disease occurs most frequently in the humid gulf-coast region.

The control measures recommended for other foliar diseases should aid in controlling Sudan grass leaf rust. Greenleaf has been reported as a rust-resistant variety.

Charcoal Rot

Charcoal rot occurs on a large number of cultivated plants, including Sudan grass, in the Southern United States. Mature plants or those well past the seedling stage are usually affected. Diseased plants often occur in circular spots in a field, where they dry and ripen prematurely, generally during the onset of high temperature and drought. The fungus responsible produces a spongy rot and shredding at the base of the culms and in adjacent stem and root tissues. The rot may extend for some distance up the stalk and down into the roots. The inside of a diseased stalk is usually stringy and in various stages of disintegration. Numerous sclerotia, or small dark fruiting bodies, of the fungus can be found on the stringy portions inside a diseased stalk. These sclerotia are very resistant to drought and temperature extremes and are able to survive in soil or in plant tissues for many years. The ability of the fungus to survive in infested soil makes the disease difficult to control.

Control measures include increasing the organic matter in the soil and supplying water when needed. Some varieties of Sudan grass, such as Sweet Sudan, tolerate the disease better than others, but no varieties are highly resistant.

Covered and Loose Kernel Smut

Sudan grass is susceptible to the two kernel smuts that attack sorghum, especially the covered kernel smut. This smut has been reported from most parts of the United States. Infection occurs only in the seeding stage from smut spores on the seed or perhaps in the soil. The fungus threads then penetrate throughout the growing Sudan grass plant, but the disease does not become evident until heading time, when it will be noticed that individual kernels are being replaced by a dark-brown to black mass of smut spores covered by a grayish membrane. These spore masses look like an elongated seed, fully twice as large as the healthy kernels. Although this disease of the seed is not a factor in the production of Sudan grass for pasture and hay, it is important when new improved strains of this grass are grown for seed.

Loose kernel smut is less common than covered kernel smut, but it affects the plants more severely. The smut is scattered shortly after it appears.

Both smuts are readily controlled by treating the seed with an effective fungicide. The volatile organic mercurials are most effective, because they kill not only the smut spores on the outer surface of the seed but also those under the glumes. The smut spores are not

reached by such nonvolatile fungicides as copper carbonate, Arasan, Phygon, and Spergon. The organic mercurials, such as Ceresan M, MEMA, and Panogen, are most effective but should not be used in excess, as seed injury will result. Seed treated with organic mercurials should be planted as soon as possible to avoid injury from the fungicides. All treated seed should be handled with care to avoid accidental poisoning. Seed treatment is more fully discussed in Farmers' Bulletin 2069, Cereal Smuts and Their Control.

Insect Enemies and Their Control [7]

Grasshoppers

Grasshoppers frequently do considerable damage to Sudan grass. If very abundant, they strip the leaves from the plants and feed on the heads.

Fields may be protected from grasshopper injury by destroying the young nymphs in adjacent field margins, ditchbanks, or wastelands with an insecticide before they move into the Sudan grass. If a heavy infestation is already present, the crop itself may be treated. Spray with heptachlor at a rate of 2 to 4 ounces per acre. Use an emulsifiable concentrate, and dilute it with water to suit available equipment. Apply the material with a ground sprayer or by airplane.

Proper tillage in the fall or spring, if in conformance with good soil-conservation practices, will destroy large numbers of grasshopper eggs and reduce subsequent infestation in the vicinity.

Chinch Bug

The chinch bug in some years is a serious pest of Sudan grass. On hatching, the young nymphs feed for a time in fields of small grain and then migrate into adjoining fields of the grass as the grain ripens and dries up. They suck juice from the plants, weakening and sometimes killing them.

A field of Sudan grass can be protected from an invasion of chinch bugs by means of a barrier made by spraying with dieldrin at the rate of ½ pound per acre in strips between the small-grain field and the field to be protected. Use an emulsifiable concentrate diluted with water. Each strip should be about 4 rods wide, and half of the spray should fall on each crop. Strips about 2 rods long should be sprayed crosswise at each end of the long strip. The chinch bugs are killed as they come into contact with the insecticide all along the barrier. Prepare the barrier a few days before the bugs migrate. It will remain effective for 1 or 2 weeks in fair weather.

Sorghum Midge

The sorghum midge sometimes prevents the profitable production of Sudan grass seed in the South, from central Texas east to the Atlantic coast. The adults lay their eggs in the flowers, and the larvae hatching from them suck the juices from the developing seed. They cause little injury to grass grown for forage.

Fields of Sudan grass should be located as far as possible from outside sources of infestation, such as Johnson grass or older fields of sorghum. The possibility of damage will be reduced if the Sudan grass comes into bloom at a time when the adult insects are not abundant in the fields. Insecticides have not yet proved practicable for the control of this midge.

[7] Prepared by the Cereal and Forage Insects Section, Entomology Research Branch.

Other Insect Pests

Several other insects that are common pests of corn and the sorghums sometimes injure Sudan grass. Among them are the armyworm, billbug, corn leaf aphid, southwestern corn borer, white grub, and wireworm.

For further information regarding pests of Sudan grass, write to your State agricultural experiment station or to the Entomology Research Branch, Agricultural Research Service, United States Department of Agriculture, Beltsville, Md.

Caution

Dieldrin and heptachlor are poisonous. Handle these insecticides with care and in accordance with directions on the labels. Keep them out of reach of children and animals.

Do not allow livestock to feed on Sudan grass treated with heptachlor for 10 days after application. If dieldrin is used as a barrier to control chinch bugs, do not harvest the treated grain in the 7-day period following the spraying, and do not feed the treated Sudan grass to livestock.

Causal Organisms of Sudan Grass Diseases

Disease	*Causal organism*
Anthracnose	*Colletotrichum graminicola* (Ces.) G. W. Wils.
Bacterial eye spot	*Pseudomonas syringae* v. Hall
Bacterial streak	*Xanthomonas holcicola* (Elliott) Starr & Burkh.
Bacterial stripe	*Pseudomonas andropogoni* (E. F. Sm.) Stapp
Charcoal rot	*Macrophomina phaseoli* (Maub.) Ashby
Covered kernel smut	*Sphacelotheca sorghi* (Lk.) Clint.
Gray leaf spot	*Cercospora sorghi* Ell. & Ev.
Leaf blight	*Helminthosporium turcicum* Pass.
Leaf rust	*Puccinia purpurea* Cke.
Loose kernel smut	*Sphacelotheca cruenta* (Kühn) Potter
Rough spot	*Ascochyta sorghina* Sacc.
Target spot	*Helminthosporium sorghicola* Lefebvre & Sherwin
Zonate leaf spot	*Gloeocercospora sorghi* D. Bain & Edg.

Common and Scientific Names of Insect Enemies

Common name	*Scientific name*
Armyworm	*Pseudaletia unipuncta* (Haw.)
Chinch bug	*Blissus leucopterus* (Say)
Corn leaf aphid	*Rhopalosiphum maidis* (Fitch)
Sorghum midge	*Contarinia sorghicola* (Coq.)
Southwestern corn borer	*Diatraea grandiosella* Dyar

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